

# Digital Transformation and Artificial Intelligence in the Military Education Systems of Azerbaijan and Türkiye: a Comparative Analysis

## Цифрова трансформація та штучний інтелект у системах військової освіти Азербайджану і Туреччини: порівняльний аналіз

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Received: July 30, 2026 | Revised: August 25, 2026 | Accepted: August 31, 2026

UDC 355.233:004.8(479.24+560)

DOI: <https://doi.org/10.33445/sds.2026.16.4.32>

**Purpose.** To comparatively analyze the level of implementation of digital innovations and artificial intelligence technologies in the military education systems of Azerbaijan and Türkiye based on established criteria, and to scientifically assess the existing differences, strengths, and prospects for further development.

**Method:** The study was conducted based on comparative qualitative analysis, a review of the relevant literature, and an analysis of strategic and institutional documents.

**Theoretical implications.** The strategic importance attached to digitalization, artificial intelligence, simulation, and cybersecurity in the military education systems of Azerbaijan and Türkiye constitutes the principal similarity, whereas the higher institutional and technological maturity of these areas in Türkiye, compared with their ongoing development and formative stage in Azerbaijan, represents the key difference.

**Practical implications.** The establishment of joint artificial intelligence laboratories and simulation centers, the organization of joint cybersecurity training programs, the development of digital education platforms, and the expansion of academic cooperation could make a significant contribution to enhancing the innovation potential of the military education systems of Azerbaijan and Türkiye, institutionalizing the exchange of expertise, and improving the quality of modern military personnel training.

**Value.** The aim is to comprehensively compare the main directions of digital transformation in the military education systems of Azerbaijan and Türkiye, thereby identifying the differences in their institutional, technological, pedagogical, and human capital capacities, as well as opportunities for mutual development.

**Paper type.** Theoretical.

**Мета дослідження.** Здійснити порівняльний аналіз рівня впровадження цифрових інновацій і технологій штучного інтелекту в системах військової освіти Азербайджану та Туреччини за визначеними критеріями, а також науково оцінити наявні відмінності, сильні сторони й перспективи подальшого розвитку.

**Метод дослідження.** Дослідження проведено із застосуванням порівняльного якісного аналізу, огляду відповідної наукової літератури та аналізу стратегічних й інституційних документів.

**Теоретична цінність дослідження.** Основною спільною рисою є стратегічне значення, якого в системах військової освіти Азербайджану й Туреччини надають цифровізації, штучному інтелекту, технологіям моделювання та кібербезпеці. Ключова відмінність полягає у вищому рівні інституційної та технологічної зрілості цих напрямів у Туреччині, тоді як в Азербайджані вони перебувають на етапі становлення й подальшого розвитку.

**Практична цінність дослідження.** Створення спільних лабораторій штучного інтелекту та центрів моделювання, організація спільних навчальних програм із кібербезпеки, розроблення цифрових освітніх платформ і розширення академічної співпраці можуть істотно сприяти підвищенню інноваційного потенціалу систем військової освіти Азербайджану й Туреччини, інституціоналізації обміну досвідом та покращенню якості сучасної підготовки військових фахівців.

**Цінність дослідження.** Комплексне порівняння основних напрямів цифрової трансформації систем військової освіти Азербайджану й Туреччини дало змогу визначити відмінності в їхньому інституційному, технологічному, педагогічному та кадровому потенціалі, а також окреслити можливості взаємного розвитку.

**Тип статті.** Теоретична.

**Key words:** Military Education; Artificial Intelligence; Digital Innovations; Military Personnel Training; Azerbaijan–Türkiye Cooperation; Digital Transformation.

**Ключові слова:** військова освіта; штучний інтелект; цифрові інновації; підготовка військових фахівців; азербайджансько-турецьке співробітництво; цифрова трансформація.

## Introduction

The rapid development of digital technologies is significantly transforming the nature of contemporary military operations, armed forces management processes, and military personnel training systems. Artificial intelligence (AI), big data analytics, cloud computing, cybersecurity tools, digital simulation systems, and automated decision-support technologies are creating a new technological environment in which traditional approaches to military education no longer fully meet the requirements of modern operations. Under these conditions, the digital transformation of military education has acquired strategic importance, as it is directly related to the ability of armed forces to develop human capital capable of operating effectively in a technologically intensive, information-rich, and dynamically changing security environment.

In the context of the Fourth Industrial Revolution, artificial intelligence has become one of the key drivers of technological change not only in the economic and social spheres but also in the defense and security sector. AI-based systems are increasingly used for processing large volumes of data, threat forecasting, decision support, the operation of unmanned platforms, operational environment modeling, mission planning, and resource optimization. Accordingly, the introduction of such technologies into military activities is changing the requirements for the professional competencies of military personnel. A modern officer must not only be proficient in the use of weapons and military equipment but also be capable of working with digital information flows, critically assessing outputs generated by algorithmic systems, interacting with intelligent technologies, and making well-founded decisions under time constraints and high levels of uncertainty.

Consequently, the content, methods, and technologies of military education are also undergoing transformation. The use of electronic learning platforms, virtual and augmented reality technologies, digital training systems, simulation complexes, cybersecurity laboratories, and adaptive learning systems creates opportunities for a transition from predominantly traditional training models to technologically integrated educational environments. Particular importance is attached to AI-based adaptive learning systems, which make it possible to consider learners' individual characteristics, learning pace, prior educational outcomes, and the level of development of specific competencies.

At the strategic level, the development and responsible use of artificial intelligence are increasingly being integrated into the defense policies of NATO, the European Union, and leading military powers. NATO's Artificial Intelligence Strategy considers AI to be one of the key technological enablers of future operational capability, while emphasizing the necessity of its responsible, reliable, and secure use (NATO Artificial Intelligence Strategy). This indicates that the digital transformation of military education should be regarded not merely as the modernization of educational and technical infrastructure, but as an integral component of the long-term development of national defense capabilities and military human capital.

The experience of Azerbaijan and Türkiye is of particular scientific and practical interest. The strategic partnership between the two countries has created favorable conditions for deepening cooperation in defense, military education, professional training, joint exercises, and defense industry development. Türkiye's experience in modernizing its armed forces, defense industry, and military education system represents an important source of institutional and technological practices for Azerbaijan. At the same time, the modernization of the Armed Forces of Azerbaijan and the orientation of its military education system toward contemporary international standards have increased the relevance of systematically integrating digital technologies and artificial intelligence tools into military personnel training.

Despite the expanding use of digital technologies in military education, their integration differs considerably across countries. Issues related to the institutional mechanisms of AI implementation, the relationship between technological innovation and pedagogical models, the

organizational prerequisites for digital transformation, and the criteria for assessing its effectiveness remain insufficiently systematized. Particular attention should be paid to comparing the practices of strategically cooperating states because technological compatibility in military education may influence interoperability, personnel training quality, and the ability to conduct joint operations.

The aim of this article is to conduct a comparative analysis of the implementation of artificial intelligence and digital innovations in the military education systems of Azerbaijan and Türkiye and to identify promising directions for their further development.

To achieve this aim, the study addresses the following objectives: to identify the theoretical foundations of the digital transformation of military education; to systematize the main areas of AI and digital technology application in military training; to compare the organizational, technological, and educational-methodological approaches used in Azerbaijan and Türkiye; to identify common trends, differences, and problematic aspects; and to substantiate promising directions for the further development of the digital military education environment.

### **Literature Review**

The digital transformation of military education lies at the intersection of several research areas, including artificial intelligence, digital pedagogy, professional military education, modeling and simulation, cybersecurity, knowledge management, and organizational digital transformation. This interdisciplinary character requires artificial intelligence in military education to be considered not as an isolated technological tool but as an element of a complex sociotechnical system encompassing curricula, teaching staff, learners, digital infrastructure, information resources, assessment systems, and institutional governance mechanisms.

From a theoretical perspective, artificial intelligence is understood as a set of methods and technologies capable of performing selected functions traditionally associated with human cognitive activity, including pattern recognition, learning from data, classification, forecasting, recommendation generation, and decision support. In education, these capabilities create opportunities for personalized learning, automated assessment, adaptive learning pathways, and the analysis of learner behavior.

In military education, the capacity of digital technologies to reproduce complex operational environments without the continuous deployment of real forces and equipment is particularly important. Simulation systems, virtual trainers, and digital scenarios make it possible to model combat and crisis situations, modify initial conditions, repeat training episodes, and record individual and collective performance. This broadens opportunities for developing command competencies, situational awareness, critical thinking, and decision-making skills.

A separate body of research focuses on adaptive learning systems. Their conceptual basis lies in the use of data on learning outcomes, behavioral characteristics, and educational activity to adjust the complexity, sequence, or format of instructional content. In military education, adaptability may be especially important because of differences in the initial training levels of cadets and officers, the need to develop specific professional competencies, and the limited time available for personnel preparation.

Virtual and augmented reality technologies also occupy an important place in contemporary scholarly discourse. These technologies allow training to be conducted in visually and spatially realistic environments, enable the rehearsal of procedures in complex or potentially hazardous situations, and facilitate the integration of educational scenarios with digital simulators. When combined with artificial intelligence, they create conditions for dynamic training environments in which scenarios can evolve in response to the decisions made by learners.

At the same time, scientific publications and strategic documents increasingly emphasize not only the potential benefits of AI but also the risks associated with its use. These include algorithmic bias, insufficient explainability of outputs, model errors, cybersecurity threats, unauthorized access

to data, dependence on technology providers, and challenges related to the protection of personal and official information. In the military context, such risks are especially significant because errors or compromise of digital systems may affect not only the quality of education but also the future professional behavior of military personnel.

An important methodological principle of contemporary approaches is the preservation of a meaningful human role in processes supported by artificial intelligence. In military education, this means that technology should augment the capabilities of instructors, commanders, and learners rather than replace professional judgment. This is particularly relevant to the development of command competencies, ethical qualities, responsibility for decisions, and the ability to act effectively in non-standard situations.

NATO strategic documents complement the academic discourse by establishing principles for the responsible use of artificial intelligence. These principles emphasize lawfulness, responsibility, explainability, reliability, governability, and the mitigation of unintended algorithmic bias (NATO Artificial Intelligence Strategy). From the perspective of military education, these principles have a dual significance: they should guide both the direct use of AI within the learning process and the development of future officers' competencies in employing intelligent systems during professional activities.

Research on digital transformation also emphasizes that technological infrastructure alone does not guarantee improvements in educational quality. The effectiveness of digitalization depends on the alignment of technologies with educational objectives, competency models, teaching methods, assessment systems, the digital literacy of academic staff, and institutional readiness for change. Therefore, the analysis of military education should distinguish at least three interconnected dimensions of digital transformation: technological, organizational-institutional, and educational-methodological.

For Azerbaijan and Türkiye, the analysis of military education digitalization is particularly relevant in the context of strategic partnership and practical interaction between their armed forces. Cooperation in military training, joint exercises, and defense-industrial development creates opportunities for the exchange of educational practices, harmonization of selected approaches to professional training, and enhancement of technological interoperability.

At the same time, the review of the scholarly discourse makes it possible to identify a research gap. Existing studies predominantly address either the general potential of artificial intelligence in education, individual military training technologies, or strategic aspects of AI use in the defense sector. Considerably less attention has been devoted to a comprehensive comparison of the military education systems of Azerbaijan and Türkiye specifically in terms of institutional readiness, digital infrastructure, AI applications, simulation technologies, and development prospects. Addressing this gap provides the theoretical foundation for the comparative analysis undertaken in this study.

## **Materials and Methods**

The study employs a comparative qualitative research design aimed at identifying common characteristics, differences, and development prospects related to digital technologies and artificial intelligence in the military education systems of Azerbaijan and Türkiye. The selection of these countries as comparative cases is justified by their strategic military-political partnership, substantial cooperation in military education and personnel training, and ongoing processes of modernization within their armed forces and military educational institutions.

The object of the study is the process of digital transformation in the military education systems of Azerbaijan and Türkiye.

The subject of the study comprises the organizational, technological, and educational-methodological mechanisms for implementing artificial intelligence and digital innovations in military personnel training systems in the two countries.

The empirical and information base of the study consists of scholarly publications on artificial intelligence, digital education, and professional military training; strategic and conceptual documents concerning defense and AI development; materials characterizing the transformation of military education in Azerbaijan and Türkiye; and open-source data published by military educational institutions, governmental authorities, and international organizations. The analysis includes materials directly related to the use of digital learning platforms, artificial intelligence, simulation technologies, virtual and augmented reality, cybersecurity training, and digital support tools in the educational process.

The principal research method is comparative analysis, which is used to examine and contrast the approaches adopted by Azerbaijan and Türkiye toward the digitalization of military education. The comparison is conducted not merely on the basis of the presence of particular technologies but also in terms of their functional purpose, level of integration into the educational process, and institutional conditions of application. This approach helps avoid the oversimplified interpretation of digitalization as merely the number of implemented technological solutions.

A literature analysis method is applied to systematize scholarly approaches and identify the theoretical foundations for the use of artificial intelligence, adaptive learning, digital simulations, and virtual learning environments in the professional education of military personnel.

Document analysis is employed to examine strategic, normative, and conceptual documents that define the directions of artificial intelligence development, digital transformation in the defense sector, and modernization of military education. Particular attention is paid to provisions regulating the principles of responsible AI use, cybersecurity requirements, digital infrastructure, and personnel training.

Content analysis is used to thematically categorize information concerning the practical applications of digital technologies in military education. To ensure comparability of the materials, the following analytical categories are used:

1. digital educational infrastructure and electronic learning platforms;
2. application of artificial intelligence in the educational process;
3. adaptive and personalized learning technologies;
4. simulation systems, digital trainers, and VR/AR technologies;
5. cybersecurity training and specialized laboratories;
6. integration of digital technologies into the professional education of officers;
7. institutional mechanisms of digital transformation;
8. challenges, risks, and limitations associated with the use of artificial intelligence.

A systems approach is used to conceptualize military education as a complex system in which technological solutions interact with human resources, educational programs, organizational structures, and governance mechanisms. This makes it possible to consider AI implementation not as an isolated technical innovation but as a factor contributing to the institutional transformation of military education.

Structural-functional analysis is applied to identify the role of specific digital technologies in performing the core functions of military education, including knowledge acquisition, development of practical skills, operational environment modeling, decision support, assessment of learning outcomes, and individualization of training.

At the final stage, synthesis and generalization methods are used to integrate the results of the comparative analysis into a comprehensive understanding of the current state of digital transformation in the military education systems of Azerbaijan and Türkiye and to identify promising directions for their further development.

The research procedure consists of four consecutive stages. At the first stage, theoretical approaches to the digital transformation of military education and the use of artificial intelligence are systematized. At the second stage, a set of comparative criteria is developed. At the third stage, the practices of Azerbaijan and Türkiye are compared according to the defined analytical categories. At the fourth stage, the identified trends, challenges, and differences are generalized, and prospective directions for the development of the digital military education environment are formulated.

A methodological limitation of the study is its predominant reliance on open-source information. Given the specific characteristics of the military domain, some information regarding particular technological solutions, algorithms, software systems, technical parameters of military simulators, and internal educational procedures may be subject to restricted access. Therefore, the findings primarily reflect institutional and technological trends that are accessible for scholarly analysis, rather than the full range of classified or restricted capabilities of the military education systems under examination.

## **Results**

### **Theoretical Foundations of Digital Innovations and Artificial Intelligence Technologies in Military Education**

In the scientific literature, digital transformation is characterized not merely as a process of technological modernization but as a fundamental change in management approaches and operational principles. Klaus Schwab argues that the defining characteristic of the Fourth Industrial Revolution is the integration of digital, physical, and biological technologies, which is generating profound transformations across all sectors, including education (Schwab, K., p. 84). From this perspective, military education has likewise become an integral part of the ongoing technological transformation. The preparation of modern military professionals extends beyond the acquisition of tactical and strategic knowledge to include competencies in operating digital platforms, analyzing large volumes of data, utilizing automated command and control systems, and applying artificial intelligence (AI)-based decision support technologies.

The implementation of digital innovations in military education primarily aims to enhance the quality and effectiveness of the educational process. Electronic learning platforms provide continuous access to instructional materials, strengthen interactive communication between instructors and cadets, and facilitate personalized learning opportunities. Multimedia resources, video lectures, electronic assessments, and virtual laboratories complement conventional classroom instruction and contribute to more efficient knowledge acquisition. In particular, the advancement of distance learning technologies has played a significant role in ensuring the continuity and flexibility of military education.

One of the most significant directions of digital innovation is the integration of Virtual Reality (VR) and Augmented Reality (AR) technologies into military education. These technologies enable the safe simulation of complex tactical situations, repeated execution of various combat scenarios, and improvement of cadets' psychological readiness. Simulation systems have become an indispensable component of practical military training in areas such as urban warfare, mountain operations, unmanned aerial vehicle (UAV) control, and decision-making in emergency situations. This approach is considered not only more cost-effective but also capable of minimizing the risks associated with the intensive use of real military equipment during training.

In recent years, one of the most influential aspects of digital transformation has been the integration of artificial intelligence technologies into educational systems. Artificial intelligence is generally defined as a collection of technologies and software capable of performing functions traditionally associated with human intelligence, including learning, reasoning, analysis, and decision-making. Russell and Norvig describe AI as the science of designing rational agents capable

of acting purposefully within dynamic environments (Russell, S., Norvig, P., p. 688). This theoretical perspective has found practical application within military education.

In contemporary military higher education institutions, AI-based systems are utilized for educational planning, assessment of cadet performance, development of adaptive learning programs, and simulation of tactical scenarios. Adaptive learning systems analyze learners' knowledge levels, learning progress, and common errors, subsequently providing personalized instructional materials tailored to individual educational needs. Such systems not only improve learning efficiency but also enable instructors to organize educational activities more effectively. Researchers emphasize that artificial intelligence should be regarded not as a replacement for instructors but rather as a supportive technology that enhances the overall quality of teaching and learning processes (Ouyang, F., Jiao, P.; Mammadzada, M., 2021).

Another important application of artificial intelligence in military education involves the development of decision-making competencies. Modern battlefield environments require military commanders to process extensive volumes of information within extremely limited timeframes and make optimal operational decisions. AI-powered simulation systems generate diverse tactical scenarios, evaluate potential risks, and analyze the consequences of cadets' decisions in real time. These technologies significantly contribute to the development of analytical thinking, risk assessment capabilities, and rapid decision-making skills among future military officers.

Digital innovation is also closely connected with the analysis of Big Data. Contemporary military operations generate enormous amounts of information from satellites, unmanned aerial systems, radar technologies, and numerous other intelligence sources. The effective processing and interpretation of these large datasets are possible only through advanced artificial intelligence algorithms. Consequently, future military officers must acquire competencies in big data analytics, machine learning, and AI-based decision support systems. The Organisation for Economic Co-operation and Development (OECD) likewise emphasizes that the rapid development of artificial intelligence necessitates the acquisition of new professional competencies and the continuous modernization of educational curricula (OECD, 2023).

Cybersecurity education has also become an essential component of digital innovation in modern military training. As digital infrastructure expands, the scale and sophistication of cyber threats continue to increase. Therefore, the establishment of cyber ranges, cybersecurity laboratories, and cyberattack simulation environments has become a strategic priority for military educational institutions. NATO's Artificial Intelligence Strategy emphasizes that AI systems employed within the defense sector must adhere to the principles of reliability, transparency, security, accountability, and meaningful human oversight (NATO Artificial Intelligence Strategy). Mastering these principles has become an indispensable element of professional military education and officer training.

Overall, digital innovations and artificial intelligence technologies have become integral components of contemporary military education. Their significance extends beyond the modernization of instructional methods to encompass improvements in military command and control, operational planning, and the overall quality of professional military education. For strategically cooperating countries such as Azerbaijan and Türkiye, studying and exchanging experiences related to digital transformation can substantially contribute to aligning military education systems with international standards, expanding the implementation of innovative technologies, and preparing highly qualified military professionals. Consequently, digital innovations and artificial intelligence represent one of the principal driving forces behind the modernization of military education and play a strategic role in developing military personnel capable of responding effectively to the challenges of the future security environment.

#### **Digital Innovations and Artificial Intelligence in the Turkish Military Education System**

Over the past decades, alongside the rapid development of its defense industry, the Republic of Türkiye has made the modernization of its military education system one of the principal priorities

of its national defense policy. The changing nature of the contemporary security environment, the proliferation of hybrid warfare, the increasing scale of cyber threats, and the expanding use of unmanned platforms and artificial intelligence (AI)-enabled weapon systems in military operations have necessitated the adoption of new approaches to military personnel training. In this context, digital transformation within Turkish military education is regarded not merely as a process of technological modernization but as a comprehensive restructuring of educational content, management models, and officer training concepts in accordance with advanced digital technologies. Institutional reforms implemented in recent years, particularly the establishment of the National Defence University (Milli Savunma Üniversitesi – MSÜ) and the introduction of a unified governance model, have represented a significant milestone in this transformation.

Established in 2016, the National Defence University unified all Turkish military higher education institutions under a single academic and administrative framework. This organizational model has facilitated the standardization of educational programs, the expansion of scientific research activities, and the integration of modern information technologies into the educational process. In addition to traditional military training, the university's constituent institutions—the Military Academy of Land Forces, Naval Academy, and Air Force Academy—place particular emphasis on specialized disciplines such as cybersecurity, software engineering, artificial intelligence, unmanned systems, data analytics, and digital management.

The contemporary operational concept of the Turkish Armed Forces is based on the principles of network-centric warfare, information superiority, and rapid decision-making. Under these conditions, it is no longer sufficient for future officers to possess only conventional military knowledge. They are also expected to acquire competencies in big data processing, digital information systems, artificial intelligence algorithms, and automated command and control platforms. To achieve these objectives, military educational institutions extensively employ e-learning platforms, adaptive learning systems, and advanced simulation technologies. Digital educational resources not only provide learners with continuous access to instructional materials but also enable instructors to monitor individual learning progress and performance.

One of the most significant areas of digital innovation in Turkish military education is the application of Virtual Reality (VR) and Augmented Reality (AR) technologies. Through sophisticated simulation systems, cadets participate in virtual environments that closely replicate real combat conditions, allowing them to perform a wide range of tactical missions in a safe and controlled setting. These systems play a vital role in operational planning, urban warfare, border security operations, air defense training, UAV operations, and decision-making under crisis conditions (Zawacki-Richter, O., Marín, V. I., Bond, M., Gouverneur, F., 2019). According to NATO experts, simulation-based training not only improves the efficient utilization of material resources but also significantly enhances the practical readiness and operational competence of military personnel (Russell, S., Norvig, P., 2021).

Leading Turkish defense companies—including HAVELSAN, ASELSAN, ROKETSAN, and Turkish Aerospace Industries (TUSAŞ)—make substantial contributions to the digital transformation of military education (HAVELSAN; Azərbaycan Respublikası Prezidenti, 2023, August 28; ROKETSAN; TUSAŞ). In particular, simulation and command-post training systems developed by HAVELSAN are widely implemented at the National Defence University and various military training centers of the Turkish Armed Forces. These systems enable the creation of diverse tactical scenarios, operational planning exercises, and real-time evaluation of trainees' decision-making processes. Furthermore, command-and-control systems and digital communication technologies developed by ASELSAN provide future officers with practical experience in the use of modern military management systems (ASELSAN).

The integration of artificial intelligence technologies into the Turkish military education system is primarily achieved through adaptive learning platforms and AI-supported decision support systems. AI-powered educational platforms continuously analyze learners' academic performance,

identify their strengths and weaknesses, and generate personalized learning pathways. This approach enables instructors to organize educational activities more efficiently, identify knowledge gaps promptly, and improve the overall quality of instruction. Researchers emphasize that, when properly implemented, artificial intelligence significantly enhances personalized learning while ensuring more objective assessment of educational outcomes (Chen, L., Chen, P., & Lin, Z., 2020; Ouyang, F., & Jiao, P., 2021; Mammadzada, M., 2025).

Cybersecurity education constitutes another strategic priority within the Turkish military education system. The growing number of cyberattacks targeting governmental institutions and military infrastructure has transformed cybersecurity training into a strategic necessity. Consequently, the National Defence University offers specialized educational programs in cybersecurity, network defense, digital forensics, and information security aimed at strengthening future officers' operational capabilities within digital environments. In addition, practical exercises conducted in cyber ranges provide trainees with opportunities to simulate real cyberattack scenarios and develop effective defensive strategies.

The remarkable achievements of Türkiye in the development and deployment of unmanned aerial vehicles have also significantly influenced the modernization of military education. Theoretical and practical instruction related to platforms such as the Bayraktar TB2, Akıncı, Anka, and other unmanned systems has become an integral component of military curricula. Cadets not only study the technical characteristics of these systems but also acquire competencies in their operation, data processing, and AI-supported decision-making principles. This educational approach contributes to preparing future officers for the technological demands of modern warfare.

International cooperation likewise plays a crucial role in the development of Türkiye's military education system. The implementation of educational programs aligned with NATO standards, participation in multinational military exercises, and academic cooperation through Erasmus+ and other international initiatives have positively influenced the modernization of military curricula (Millî Savunma Üniversitesi). These collaborative activities facilitate the integration of advanced digital educational technologies, simulation systems, and artificial intelligence applications into Turkish military educational institutions.

Nevertheless, the implementation of artificial intelligence technologies also presents several significant challenges. These include ensuring information security, maintaining ethical standards, promoting algorithmic transparency, protecting personal data, and addressing the shortage of highly qualified specialists. As emphasized in NATO's Artificial Intelligence Strategy, AI systems employed in the defense sector must operate in accordance with the principles of human oversight, accountability, reliability, and compliance with legal and ethical standards (NATO, 2021, October 22). Türkiye likewise incorporates these principles into its national strategies and continuously updates its military education programs accordingly.

In conclusion, the integration of digital innovations and artificial intelligence technologies into the Turkish military education system has become an essential component of the country's national defense strategy. The unified academic model established by the National Defence University, close cooperation with the defense industry, the extensive application of artificial intelligence and simulation technologies, specialized cybersecurity education, and the implementation of training approaches consistent with international standards collectively demonstrate Türkiye's substantial achievements in this field. This experience may serve as a valuable scientific and practical model for the modernization of military education systems in friendly and allied countries, including the Republic of Azerbaijan.

#### **Digital Transformation Processes in the Military Education System of Azerbaijan**

In recent years, the policy of digital transformation implemented across all sectors of public administration in the Republic of Azerbaijan has also had a significant impact on the development of the defense sector and the military education system. The contemporary geopolitical

environment, changes in the regional security landscape, the expansion of information warfare, and the increasing deployment of high-technology weapon systems have generated new competency requirements for military personnel. Under these circumstances, reliance solely on traditional teaching methods is no longer sufficient for military education institutions. Future military officers are expected to possess comprehensive knowledge and practical skills in digital technologies, AI, cybersecurity, automated command-and-control systems, and big data analytics. Consequently, one of the principal directions of military education reforms in Azerbaijan has been the systematic integration of digital technologies into educational and training processes.

The document *"Azerbaijan 2030: National Priorities for Socio-Economic Development,"* approved by the President of the Republic of Azerbaijan, identifies digital transformation, the development of an innovation-driven economy, and the strengthening of human capital as key strategic priorities for the country's future development (Azərbaycan Respublikası Prezidenti, 2021, February 2). These priorities are equally applicable to the defense and national security sectors. The advancement of digital public administration, the widespread implementation of information and communication technologies (ICT), and the promotion of innovative governance approaches have stimulated the introduction of new educational models within the military education system. Furthermore, the *"Socio-Economic Development Strategy of the Republic of Azerbaijan for 2022–2026"* defines digitalization and innovation as central pillars of state policy and recognizes the preparation of highly qualified human resources as one of the country's priority objectives (Azərbaycan Respublikası Prezidenti, 2022, July 22).

The military education system of Azerbaijan is primarily represented by the Heydar Aliyev Military Institute, the Military Management Institute, the Military Medical Faculty of Azerbaijan Medical University, and several other specialized military educational institutions. During recent years, comprehensive measures have been undertaken to modernize educational processes in these institutions in accordance with contemporary international standards. The development of electronic educational resources, the establishment of digital libraries, the creation of interactive classrooms, and the extensive implementation of ICT have significantly contributed to improving the quality of military education. In particular, electronic learning platforms provide cadets with continuous access to educational materials while simultaneously enabling instructors to monitor individual learning trajectories and assess educational outcomes efficiently through digital assessment tools.

The successful employment of advanced technologies by the Armed Forces of Azerbaijan during the 44-day Patriotic War, including UAVs, digital communication systems, and modern command-and-control technologies, has highlighted the necessity of revising military educational curricula. The operational experience gained during the conflict demonstrated that modern military officers must possess not only tactical and operational competencies but also the ability to operate digital information systems, analyze intelligence received from multiple sources, and make timely decisions under dynamic battlefield conditions. Consequently, greater emphasis has been placed on information technologies, cybersecurity, unmanned systems, and digital command-and-control disciplines within military education programs.

One of the most significant dimensions of digital transformation in military education is the integration of simulation technologies into the training process. Modern simulation systems enable cadets to develop practical competencies in tactical decision-making, command and control, operational planning, and mission execution within environments that closely replicate real combat conditions. Compared with conventional field exercises, simulation-based training offers substantial advantages by allowing military personnel to repeatedly practice a wide range of operational scenarios without the extensive use of costly military equipment or logistical resources. This approach not only improves training efficiency but also minimizes financial costs while ensuring the safety of personnel. According to the North Atlantic Treaty Organization (NATO), simulation-based

education and training represent one of the most effective methods for enhancing the professional competence and operational readiness of military personnel (NATO, 2025, December 17).

Recent reforms in the field of cybersecurity have also exerted a considerable influence on the development of Azerbaijan's military education system. The *Strategy of the Republic of Azerbaijan on Information Security and Cybersecurity for 2023–2027*, adopted in 2023, identifies the enhancement of digital competencies within public institutions, the strengthening of cybersecurity specialist training, and the broader implementation of innovative technologies as national strategic priorities (Azərbaycan Respublikası Prezidenti, 2023, August 28). This policy document provides an important methodological foundation for military educational institutions by encouraging the development of new cybersecurity curricula, the establishment of specialized laboratories, and the expansion of practical cyber-defense training. As cybersecurity increasingly becomes an essential component of national defense, the preparation of military professionals capable of protecting critical information infrastructure has emerged as one of the principal objectives of military education.

Another important aspect of digital transformation is the gradual integration of artificial intelligence technologies into military education. Similar to the practices adopted by leading military academies around the world, Azerbaijan considers AI-based educational systems to be one of the most promising directions for future development. Artificial intelligence technologies can analyze individual learning performance, generate adaptive educational content, personalize learning pathways according to cadets' competencies, automate assessment procedures, and provide objective analyses of educational outcomes. Consequently, AI-supported learning environments have the potential to increase both the efficiency and quality of military education by promoting individualized instruction and evidence-based educational management.

International cooperation also plays a crucial role in accelerating digital transformation within Azerbaijan's military education system. Educational activities implemented under NATO's *Partnership for Peace (PfP)* programme, together with participation in international training courses, professional exchange programmes, and joint educational initiatives, have significantly expanded opportunities for adopting advanced instructional technologies. Furthermore, the strategic military cooperation between Azerbaijan and Türkiye has made an important contribution to the modernization of military education through the implementation of digital innovations (NATO, 2024, May 27). Joint military exercises, faculty and cadet exchange programmes, collaborative use of simulation technologies, and the exchange of educational experience have all facilitated the modernization of curricula and the adoption of internationally recognized educational standards.

In the contemporary security environment, big data analytics, cloud computing technologies, and automated decision-support systems have become indispensable components of military command and control. Therefore, future military officers are expected not only to operate advanced weapon systems but also to analyze large volumes of digital information, effectively utilize artificial intelligence-based software applications, and accurately evaluate complex information flows in rapidly changing operational environments. The Organisation for Economic Co-operation and Development emphasizes that, within the framework of the digital economy, the development of human capital is directly associated with the acquisition of advanced digital and technological competencies (OECD, 2023). This principle is equally applicable to military education, where technological literacy has become a prerequisite for effective military leadership and operational success.

Despite these positive developments, the implementation of digital transformation within the military education system is accompanied by several challenges. The establishment of modern technological infrastructure, continuous modernization of software platforms, professional development of highly qualified academic staff, strengthening of information security mechanisms, and allocation of sufficient financial resources remain among the most significant issues requiring sustained attention. Moreover, the integration of artificial intelligence into military education raises important ethical and legal considerations, including the protection of personal data, ensuring

transparency and accountability in AI-assisted decision-making, and preserving the central role of human judgment in critical military decisions. NATO's *Artificial Intelligence Strategy* identifies these principles as fundamental requirements for the responsible application of AI technologies within the defense sector (NATO, 2021, October 22).

Overall, digital transformation within Azerbaijan's military education system is progressing in a systematic and strategically coordinated manner. National strategic policy documents, continuous investment in educational infrastructure, expansion of digital learning resources, development of cybersecurity and information technology curricula, and strengthening of international cooperation collectively constitute the principal pillars of this transformation process. Looking ahead, the broader implementation of artificial intelligence, big data analytics, digital simulation technologies, and automated command-and-control systems is expected not only to align Azerbaijan's military education system with international standards but also to contribute substantially to the preparation of highly qualified military officers capable of meeting the requirements of modern warfare and future security challenges.

### **Comparative Analysis of the Military Education Systems of Azerbaijan and Türkiye**

The comparative analysis of the application of digital innovations and artificial intelligence in the military education systems of Azerbaijan and Türkiye was conducted based on predetermined criteria, enabling a more objective assessment of the outcomes achieved by both countries. For this purpose, the dimensions of comparison were first identified. Subsequently, normative and legal documents, strategic programmes, official institutional data, and reports of international organizations concerning the current situation in Azerbaijan and Türkiye were examined for each criterion. The collected data were then compared to identify commonalities and differences. The main criteria adopted for the comparison included the strategic framework, digital learning platforms, the application of artificial intelligence, simulation technologies, cybersecurity education, integration with the defence industry, international cooperation, and human capital development. Such an approach makes it possible not only to provide a general description of the military education systems of the two countries but also to assess the level of their digital transformation on the basis of specific indicators. The results of the comparative assessment are presented in Table.

**Table:** Comparative Assessment of Digital Transformation in the Military Education Systems of Azerbaijan and Türkiye

| <b>Comparison Criterion</b>           | <b>Current Situation in Azerbaijan</b>                                                                                                                                                                                                                                                                      | <b>Current Situation in Türkiye</b>                                                                                                                                                                                                                                                                                                | <b>Comparative Academic Assessment</b>                                                                                                                               |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Strategic and Regulatory Framework | Digital transformation, innovation, and human capital development have been identified as priority areas in the strategic documents of the state. Digitalization in military education is developing in alignment with this broader national policy (Azərbaycan Respublikası Prezidenti, 2021, February 2). | The adoption of separate national strategies on artificial intelligence and digital transformation has established a more concrete institutional framework for technological development in the fields of military and higher education (T.C. Cumhurbaşkanlığı Dijital Dönüşüm Ofisi, & T.C. Sanayi ve Teknoloji Bakanlığı, 2021). | Türkiye has developed a more systematic institutional and strategic framework, whereas Azerbaijan is currently undergoing a phase of rapid development in this area. |
| 2. Digital Education Infrastructure   | The opportunities for using electronic educational resources, information and communication technologies, and digital learning tools are                                                                                                                                                                    | The unified institutional structure of the National Defence University provides broader opportunities for integrating digital education and academic management                                                                                                                                                                    | Türkiye has a higher level of institutional integration of digital education infrastructure, while Azerbaijan continues to                                           |

| Comparison Criterion                                            | Current Situation in Azerbaijan                                                                                                                                                                                                                                         | Current Situation in Türkiye                                                                                                                                                                                                                                                       | Comparative Academic Assessment                                                                                                                                                       |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                 | continuously expanding (Ağayev, Ş. O., Həşimov, E. Q., & Talibov, Ə. M., 2016).                                                                                                                                                                                         | systems (Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O., 2018).                                                                                                                                                                                           | develop its infrastructure.                                                                                                                                                           |
| 3. Application of Artificial Intelligence in Military Education | The application of artificial intelligence in education and defence is developing as a prospective area. There is a need to expand the potential of adaptive learning, learning analytics, and automated assessment.                                                    | The National Artificial Intelligence Strategy envisages the development of human capital, scientific research activities, and the technological ecosystem in the field of artificial intelligence (Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O., 2018). | Türkiye is more advanced in terms of its institutional foundations and technological ecosystem, whereas applications in Azerbaijan remain at the stage of formation and expansion.    |
| 4. Simulation and Virtual Training Technologies                 | The implementation and development of simulation-based training constitute an important direction in modern military personnel training. In particular, the integration of contemporary combat experience into education further increases the importance of this area. | Simulation and training systems developed by defence-industry enterprises such as HAVELSAN provide extensive technological capabilities for military training (HAVELSAN).                                                                                                          | Türkiye holds a stronger position in terms of the production, technological diversity, and integration of simulation technologies with the defence industry.                          |
| 5. Cybersecurity Education                                      | Cybersecurity is one of the priority areas of national policy. The 2023–2027 strategy envisages the development of relevant human capital and the strengthening of security capabilities (Azərbaycan Respublikası Prezidenti, 2023, August 28).                         | Higher education, research, and defence-industry capabilities in cybersecurity are being developed within a broader institutional environment.                                                                                                                                     | Cybersecurity is a strategic priority in both countries; however, Türkiye has broader institutional capabilities, while Azerbaijan demonstrates a high level of development momentum. |
| 6. Defence Industry–Military Education Integration              | The development of the defence industry and the expansion of indigenous technologies create new opportunities for military education. Further strengthening of this relationship at the institutional level is necessary.                                               | Defence-industry institutions such as ASELSAN, HAVELSAN, TUSAŞ, and others play an important role in the development of new technologies and the formation of a personnel-training ecosystem (ASELSAN; HAVELSAN; TUSAŞ).                                                           | Türkiye's principal advantage lies in the closer institutional coordination between the defence industry, military education, and scientific research activities.                     |
| 7. Digital Decision-Making and Analytical Capabilities          | The integration of big data analytics, digital management, and artificial intelligence-based decision-support systems into military education is regarded as a prospective area.                                                                                        | The advanced industrial ecosystem in artificial intelligence and defence technologies provides broader opportunities for implementing decision-support and analytical technologies (HAVELSAN).                                                                                     | Türkiye has a broader technological ecosystem, while for Azerbaijan it would be appropriate to strengthen domestic research and application capabilities in this field.               |

| Comparison Criterion                       | Current Situation in Azerbaijan                                                                                                                                                                                                      | Current Situation in Türkiye                                                                                                                                                                                                           | Comparative Academic Assessment                                                                                                                                                                                |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8. Human Capital and Digital Competencies  | The development of military-pedagogical personnel and officers with digital skills is among the areas currently being advanced.                                                                                                      | A broader human-capital ecosystem has been established in artificial intelligence, digital technologies, and defence-industry development (Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O., 2018).             | Türkiye is distinguished by a more mature human-capital and research infrastructure, whereas targeted personnel development should remain a priority for Azerbaijan.                                           |
| 9. International and Bilateral Cooperation | Military education and defence cooperation with Türkiye is of strategic importance. The Shusha Declaration has established the allied level of relations between Azerbaijan and Türkiye (Azərbaycan Respublikası, 2022, February 1). | Türkiye possesses extensive institutional opportunities for cooperation in military education, training, and defence.                                                                                                                  | Mutual exchange of experience and the implementation of joint digital projects represent highly promising areas for both countries.                                                                            |
| 10. Research and Development Potential     | There is considerable potential for expanding research on digital transformation and artificial intelligence; however, stronger military education–science–industry linkages are required.                                           | A broader ecosystem of research cooperation has been established among universities, defence-industry organizations, and state institutions (T.C. Cumhurbaşkanlığı Dijital Dönüşüm Ofisi, & T.C. Sanayi ve Teknoloji Bakanlığı, 2021). | Türkiye has an advantage in terms of the scale of research and industry integration.                                                                                                                           |
| 11. Institutional Maturity                 | The digital transformation process is currently at a stage of development and institutional consolidation.                                                                                                                           | More established institutional mechanisms for digital transformation and artificial intelligence are in place (T.C. Cumhurbaşkanlığı Dijital Dönüşüm Ofisi, & T.C. Sanayi ve Teknoloji Bakanlığı, 2021).                               | Türkiye demonstrates a higher level of institutional maturity, whereas Azerbaijan is undergoing a dynamic development phase.                                                                                   |
| 12. Overall Development Prospects          | Key prospects include establishing artificial intelligence laboratories, implementing adaptive learning systems, expanding simulation technologies, and deepening cooperation with the defence industry.                             | Further development of the existing technological and institutional foundations and expansion of the application areas of artificial intelligence in military education constitute the principal prospects.                            | For Azerbaijan, adapting Türkiye's experience to national characteristics is advisable, while for Türkiye, reciprocal learning from Azerbaijan's experience and regional combat realities would be beneficial. |

**Source:** compiled by the authors based on the sources cited in the table.

The military education systems of Azerbaijan and Türkiye share similar strategic objectives in terms of the main directions of digital transformation; however, differences exist in their levels of institutional maturity and technological implementation. Türkiye's principal advantages are reflected in its more systematic strategic framework for artificial intelligence and digital technologies, its advanced

defence industry, and the extensive links between military education, science, and industry. Azerbaijan's strengths, by contrast, are associated with the strategic importance attached to digitalization at the state level, its rapidly developing defence technologies, high-level military cooperation with Türkiye, and opportunities to integrate contemporary combat experience into military education. Therefore, rather than mechanically replicating the Turkish experience, a more appropriate approach for Azerbaijan would be to adapt its institutional mechanisms to the specific characteristics and requirements of the national military education system.

In general, the findings of the comparative analysis substantiate the prioritization of three main areas in the next stage of the digital transformation of Azerbaijan's military education system: the establishment of specialized educational and research infrastructure in artificial intelligence; the institutional strengthening of cooperation between military education and the defence industry; and the expansion of joint digital training and scientific research projects between Azerbaijan and Türkiye. Such an approach may enable digital technologies to be regarded not merely as instructional tools, but as a strategic factor capable of transforming the content, methodology, and outcomes of military personnel training.

### **Recommendations and Development Perspectives**

The findings regarding the implementation of digital innovations and AI technologies in the military education systems of Azerbaijan and Türkiye indicate that a systematic and long-term approach is essential to ensure sustainable future development in this field. In the contemporary security environment, technological superiority is determined not only by the acquisition of advanced weapon systems but also by the preparation of highly qualified military professionals capable of effectively operating and managing these technologies. Therefore, digital transformation in military educational institutions should be regarded not merely as a process of technological modernization but as a comprehensive transformation encompassing educational content, institutional governance, and research activities.

First, it would be appropriate to further expand specialized educational programs in artificial intelligence, machine learning, big data analytics, cybersecurity, and unmanned systems within the military higher education institutions of both countries. In this regard, the regular revision of curricula in line with current technological developments and the maintenance of an appropriate balance between theoretical knowledge and practical training can make a significant contribution to the development of future officers' professional competencies.

Another important priority concerns the expansion of joint scientific research between Azerbaijan and Türkiye. Establishing collaborative AI laboratories, digital simulation centers, and cybersecurity research platforms involving military educational institutions and defense industry organizations in both countries could accelerate the development and implementation of innovative technologies. Such cooperation would not only strengthen scientific capacity but also facilitate the establishment of common methodological approaches and promote a broader exchange of professional experience.

Another promising direction is the gradual integration of adaptive learning systems and AI-based decision support platforms into the military education process. These technologies enable a more objective assessment of learners' individual preparedness, support the personalization of instruction, and enhance the effectiveness of practical skills development. At the same time, ensuring the sustainability of digital transformation requires the modernization of the material and technical infrastructure of military educational institutions, the continuous improvement of instructors' digital competencies, and the systematic study and adoption of international best practices.

Finally, considering the strategic partnership between Azerbaijan and Türkiye, it is advisable to develop joint digital learning platforms, conduct collaborative simulation-based training exercises, expand faculty and cadet exchange programs, and implement joint scientific research projects in the fields of artificial intelligence and military education. Measures undertaken in these

areas will not only enhance the international competitiveness of the military education systems of both countries but also contribute to the establishment of an innovative and integrated military education environment across the Turkic world, the preparation of highly qualified officers capable of addressing contemporary security challenges, and the further strengthening of scientific and technological cooperation in the field of defense.

## **Discussion**

The findings confirm that the digital transformation of military education should be understood as a systemic process rather than merely the introduction of individual technological tools. The comparative analysis demonstrates that the effectiveness of artificial intelligence, simulation technologies, digital learning platforms, and cybersecurity training depends on their integration with institutional governance, educational programs, human capital development, and defence-industry cooperation. This interpretation is consistent with the theoretical approaches examined in the literature review, according to which technological infrastructure alone does not ensure improvements in educational quality.

The principal similarity between Azerbaijan and Türkiye lies in the strategic importance assigned to digitalization, artificial intelligence, simulation-based training, and cybersecurity. In both countries, these areas are regarded as necessary components of modern military personnel training. However, the results reveal differences in the maturity and institutionalization of digital transformation. Türkiye has developed a more integrated environment based on national artificial intelligence policy, a consolidated military education structure, and stronger interaction among military educational institutions, research organizations, and defence-industry enterprises. Azerbaijan, by contrast, is characterized by the dynamic development and gradual institutional consolidation of these areas.

The identified differences should not be interpreted as evidence of identical development trajectories operating at different speeds. Türkiye's model reflects its specific institutional structure, technological ecosystem, and defence-industrial capacity. Azerbaijan's military education system develops under different organizational conditions and has its own advantages, including state support for digitalization, expanding national defence capabilities, close military cooperation with Türkiye, and the possibility of integrating contemporary combat experience into educational programs. Consequently, the direct replication of Türkiye's institutional solutions would be less appropriate than their selective adaptation to Azerbaijan's national requirements and educational context.

The findings also support the position that artificial intelligence should complement rather than replace professional military judgment. Adaptive learning systems, automated assessment, learning analytics, and decision-support technologies can improve the individualization and effectiveness of training. Nevertheless, their use must preserve the meaningful role of instructors and learners, particularly in developing responsibility, critical thinking, ethical judgment, and decision-making under uncertainty. This is consistent with the principles of reliability, accountability, explainability, security, and human oversight considered in the reviewed strategic documents.

The interpretation of the results is limited by the study's reliance on open-source scholarly, strategic, and institutional materials. Restricted access to information on military technologies, internal educational procedures, algorithms, and technical characteristics of simulation systems does not permit a complete assessment of their actual scale or effectiveness. Therefore, the conclusions primarily characterize publicly observable institutional and technological trends rather than the full capabilities of the military education systems of Azerbaijan and Türkiye.

## **Conclusion**

The comparative analysis conducted demonstrates that digital transformation and the application of artificial intelligence in the military education systems of Azerbaijan and Türkiye have become

one of the key areas of development in modern military personnel training. In both countries, strategic importance is attached to the integration of digital learning platforms, simulation technologies, cybersecurity training, and artificial intelligence capabilities into military education. At the same time, the broader institutional foundation of digital transformation in Türkiye, its well-developed defence industry–education cooperation, and the existence of a national strategy on artificial intelligence have been identified as the principal distinguishing features. In Azerbaijan, these areas are at a dynamic stage of development and are expanding through the state's digitalization policy, contemporary military experience, and strategic cooperation with Türkiye.

The results of the comparative analysis indicate that adapting Türkiye's experience to Azerbaijan's national context—particularly through the establishment of joint artificial intelligence laboratories, simulation centers, digital education platforms, and joint cybersecurity training mechanisms—offers significant opportunities for enhancing the technological and pedagogical potential of military education. Thus, deepening Azerbaijan–Türkiye cooperation in the fields of digital innovations and artificial intelligence can contribute to the development of military personnel in both countries who possess advanced digital competencies and high levels of professional expertise and are capable of responding effectively to contemporary security challenges.

### **Funding**

This study received no specific financial support.

### **Competing interests**

The authors declare that they have no competing interests.

### **Use of Artificial Intelligence**

Artificial intelligence was used for language editing, translation, and technical verification of the manuscript.

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